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BAT FAUNA OF THE WESTERN HIMALAYA OF INDIA: A ZOOGEOGRAPHIC PERSPECTIVE

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Abstract
A zoogeographic analysis of the chiropteran fauna of western Himalayan states of Himachal Pradesh (HP) and Jammu & Kashmir (J&K) is presented. Based on field surveys, study of museum specimens and published literature, 44 species of bats in 20 genera have been reported from the study area. By virtue of its transitional position between the Oriental and Palearctic biogeographic realms, the chiropteran fauna of western Himalaya exhibit an intermixing of elements from both the realms. At the species level, Oriental elements (25 species) dominate Palearctic (17 species) and Ethiopian (1 species) components, while the zoogeographic affinity of one species, *Miniopterus schreibersii*, is indeterminate. Some zoogeographic aspects influencing the present faunal composition of the region are also discussed. Considering the lack of studies on bat fauna in this part of the Himalaya, it is expected that intensive studies will shed new light into the zoogeography of these lesser known mammals.

***Key words*:** Chiroptera, species diversity, zoogeographic affinity, disjunctive distribution

Introduction

The Himalaya extends over a distance of about 2500 km between 26° 20' – 35° 40' N and 74° 50' – 95°40' E (Ives & Messeril, 1989). The range is geographically partitioned into Eastern Himalaya, Central Himalaya, Western Himalaya and Northwest Himalaya (Mani, 1974a). Within Indian limits, Himalaya occupies an area of 531,250 km^2 comprising 16.6% of the total geographical area of the country (Nandi *et al.*, 2000) and it is further divided into Northeastern Himalaya comprising the states of Northeastern India, Central Himalaya including Uttarakhand State and Western Himalaya consisting of the states of Himachal Pradesh (HP) and Jammu & Kashmir (J&K) (Ahmed *et al.*, 1990). By virtue of exceptional diversity and endemicity of life forms, Himalaya is recognized as one of the 34

biodiversity hotspots of the world (Mittermier *et al.*, 2004). Biogeographically, the Himalaya constitutes a transition zone between the Palearctic and the Indo–Malayan realms and an intermixing of species from both realms is evident in its faunal composition (Corbett & Hill, 1992). Tremendous altitudinal gradient of the mountain range results in topographic variations and consequent multiplicity of ecosystems harbouring different ecological communities. Thus, the mesmerizing biodiversity of the region is the consequence of complex interplay between biogeographic, altitudinal and topographic factors.

Bats (order Chiroptera) constitute one of the most species–rich and ubiquitous mammalian orders, comprising over 1100 species (Simmons, 2005). The order consists of two suborders: Yinpterochiroptera comprising the families Pteropodidae, Rhinolophidae, Megadermatidae, Craseonycteridae and Rhinopomatidae; and Yangochiroptera encompassing the families Emballonuridae, Nycteridae, Phyllostomidae, Mormoopidae, Noctilionidae, Furipteridae, Thyropteridae, Mystacinidae, Myzopodidae, Vespertilionidae, Molossidae and Natalidae (Teeling *et al.*, 2005). In the Indian subcontinent, the order is represented by 121 species belonging to 37 genera and eight families, of which 112 species in 33 genera and eight families occur within India (Srinivasalu & Srinivasalu, 2001).

The first report on the bat fauna of western Himalaya was that of Dobson (1872), who described *Vespertilio macropus* (=*Myotis longipes*) from the Bhima Devi area of Kashmir valley. Subsequently, he described *Vespertilio murinoides* (=*Myotis blythii*) from the Chamba area of HP (erstwhile Punjab) (Dobson, 1873). Blanford, (1888–1891) in his "*Fauna of British India*" book, also listed a few bat species from this region like *Myotis muricola* from Dalhousie and Shimla and *Barbastella leucomelas* from Shimla. Subsequently, Allen (1908) reported *Rhinolophus ferrumequinum*, *Scotophilus kuhlii* and *Scotoecus pallidus* from Kullu valley of HP. Dodsworth (1913) recorded seven species of bats, namely *Pteropus giganteus, Rhinolophus ferrumequinum tragatus, Nyctalus montanus, N. labiatus, Myotis muricola, M. blythii* and *Pipistrellus coromandra* from Shimla and the adjoining hill region. Thomas (1911, 1926) described *Plecotus wardi* (earlier treated under *P. austriacus*, this taxon is presently considered distinct – Spitzenberger *et al.*, 2006) and *Myotis meinertzhageni* (=*M. nipalensis*) (Simons, 2005) from the Ladakh area. The mammal survey organized by the Bombay Natural History Society during 1912–1920 generated momentum for mammalian studies in the Indian subcontinent and as a part of that the western Himalayan region was also surveyed by workers like Major Stockley and H. W. Wells. The report on the Chamba and Kangra areas of HP was published by Lindsay (1927) and that of Kashmir (covering the Islamabad District of Pakistan–occupied Kashmir) and Punjab by Hinton and Thomas (1926). The reports included a number of species from western Himalaya, namely *Pteropus giganteus*, *Rhinolophus ferrumequinum tragatus*, *Pipistrellus javanicus* (as *P. babu* in Lindsay, 1927), *Nyctalus noctula* (as *N. labiatus* in Lindsay, 1927), *Nyctalus leisleri*, *Myotis nipalensis* (as *M. muricola* in Lindsay, 1927), *Myotis muricola* and *Plecotus wardi*. During 1966–1970, H. R. Bhat and his associates of the National Institute of Virology in Pune surveyed various parts of Western Himalaya for a study on vertebrate ectoparasites. They collected and documented several bat species from Himachal Pradesh including *Plecotus homochrous* (as *P. auritus*) from Ratandi, Shimla district, which was the first report of this species from the state (Bhat *et al.*, 1983). Sharma & Sharma (1976) reported some mammal species from Jammu valley including *Pipistrellus mimus* (=*P. tenuis*). Nath (1979, 1985, 1987) also reported a number of bat species from Kashmir valley like *Pipistrellus pipistrellus*, *P. coromandra*, *P. paterculus* and *Otonycteris hemprichi*. Chakraborty (1983) provided an account on the mammalian fauna of J&K including 27 species of bats from the state. The comprehensive work of Bates and Harrison (1997) enumerated a total of 33 species of bats in J&K and HP. Of late, a number of species, namely *Rhinolophus luctus*, *R. affinis*, *Hipposideros armiger*, *Hipposideros fulvus*, *Miniopterus schreibersii* and *Myotis siligorensis*, are added to the chiropteran inventory of the region including range extensions of a few (Saikia *et al*., 2004, 2006). Recently, Saikia *et al*. (2011) gave a detailed account on the Chiroptera of HP, however, such consolidated information is lacking for J&K. This article tries to collate

together the available information on the same and to present it in the light of past zoogeographic history.

Study area

The western Himalayan states of HP and J&K cover an area of 278,325 km^2 and spread between 30^o 18'–36^o 58' N and 72^o 30'–79^o04' E (Mehta & Julka, 2002). Biogeographically, the area comes under two biogeographic zones, the Himalaya and the Trans–Himalaya encompassing three biotic provinces (Rodger & Panwar, 1988). Four parallel physiographic zones in the region are distinguished from south to north, namely, the Shiwalik Himalaya, the Lesser Himalaya, the Great Himalaya and the Trans–Himalaya. The Shiwalik is the outermost foothills zone comprising several highly eroded low ridges and is normally below an elevation of 1500m. Districts of Sirmour, Solan, Bilaspur, Hamirpur, Una and parts of Chamba and Kangra in HP and the Jammu valley in J&K are included in this zone. The Lesser Himalaya runs from north of the Shiwalik and parallel to the Great Himalayan range. Pir Panjal and Dhauladhar are the main mountain ranges in this zone. North of the Pir Panjal range lies the Kashmir valley. The Great Himalayan ranges lie towards the north of Kashmir valley, the Chandrabhaga River in Lahaul, and Spiti in HP and comprises great peaks rising up to an elevation of over 6000m. The Great Himalayan ranges act as a barrier to the southwest monsoon and creates a rain shadow zone north of it, known as Trans–Himalaya. This region comprises districts of Ladakh and Kargil in J&K, Lahaul and Spiti valleys and Pooh Tehsil of the District Kinnaur in HP. Average annual rainfall in the area varies from 60 mm in Trans–Himalayan Ladakh region to about 2500 mm on the lower slopes of Dhauladhar range in Kangra District of HP. In higher elevations, precipitation occurs mainly in the form of snowfall and areas over 4500 m remain under snow almost year round. Natural vegetation in western Himalaya can be broadly subdivided in to the following types; (A) *Tropical forest*: confined to the foothills and consisting of either *Acacia* and *Zizyphus* scrub or deciduous *Shorea robusta* forest, (B) *Subtropical forest*: develops between 500–1800m and comprises species like *Terminalia, Albizzia,* and *Olea* (dry evergreen type) or *Pinus roxburghii* (Chir pine type), (C) *Temperate forest*: this forest develops between 1500–3000m and features two subtypes, the Himalayan moist temperate subtype which contains *Quercus* spp., *Cedrus deodara,* and *Pinus wallichiana* and the Himalayan dry temperate subtype mainly consisting of *Quercus ilex* and *Pinus gerardiana,* (D) *Sub–alpine forest*: usually found between 3000–3400m and consists of species like *Betula utilis, Abies spectabilis* and *Rhododendron campanulatum*, and (E) *Dry Alpine scrub*: consisting of scrubs of *Rhododendron campanulatum* or *Juniperus communis* at altitudes between 3200–3800m (Mehta & Julka, 2002).

Materials and Methods

Information on species diversity presented in this account is based on the first author's collections and observations during field surveys in various parts of HP, the chiropteran collection at the High Altitude Regional Centre, the Zoological Survey of India (ZSI) in Solan, and also published literature including museum catalogues. For J&K State, the data on diversity is almost entirely based on published information except for *H. fulvus* (based on a specimen at ZSI, Solan). For comparison of faunal similarity, the Simpson's coefficient ($S=N_C$ (100)/N_1, where N_C = number of taxa shared by both regions, N_1= number of taxa in the smaller region) was used (Simpson, 1960). Zoogeographic affinities of the species mentioned are derived from various publications (Chakraborty, 1983; Horáček *et al.* 2000; Koopman, 1989).

Results and Discussion

***Species diversity and zoogeographic affinity*:** The present account includes 44 species of bats in 6 families and 20 genera known from this part of western Himalaya. This represents an impressive 40% of the total bat species in India. Vespertilionidae (31 spp) is the largest family followed by Rhinolophidae (6 spp), Pteropodidae (3 spp) and Hipposideridae (2 spp) while families Megadermatidae and Rhinopomatidae are represented by a single species each. Although some of the species are widespread in the region (as evident from multiple recorded localities), a few others like *Megaderma lyra, Scotoecus pallidus, Murina tubinaris, Myotis siligorensis,* and *Pipistrellus paterculus* are each known from a single locality record. However, considering the lack of studies on bat fauna of this area, this

apparent rarity may be an artifact of under–sampling rather than rare occurrence. By virtue of its location in the transition zone between the Palearctic and the Oriental realms, the chiropteran fauna of western Himalaya exhibits an admixture of species from both. A single Ethiopian species *Rhinopoma hardwickii*, which is usually confined to an arid environment, has also been reported from the region. Among the 44 bat species known from this region, 17 are Palearctic, 25 are Oriental, one species has an Ethiopian affinity and another (*Miniopterus schreibersii*) is of indeterminate origin. The zoogeographic affinities of the bat species are given in Table 1.

***Past faunal inflow*:** The presence of the Himalaya has been a decisive factor in the distribution of plants and animals in India. While it acted as a barrier for southward and northward movements of Central Asian and Indian species respectively, Himalaya also served as a migration route for flora and fauna and has become the crossroad of different subregions of Palearctic and Oriental realms (Schaller, 1977). The historical influx of fauna from adjacent biogeographic realms to the western Himalaya is evident in the present faunal composition of the area. *Nyctalus noctula, Barbastella leucomelas, Plecotus austriacus, Rhinolophus ferrumequinum, Myotis nipalensis,* and *Pipistrellus pipistrellus* are some of the Palearctic representatives of the bat fauna of the region (Corbet & Hill, 1992; Horáček *et al*., 2000; Roberts, 1977). These elements might have entered the region either from Iran through Pakistan or down through Himalaya from the Hindukush mountains and Russian Uzbekistan (Roberts, 1977) probably during the ice age (late Tertiary period) (Fig. 2A). A few representatives of the Oriental bat fauna of the region include *Pteropus giganteus, Cynopterus sphinx, Megaderma lyra, Hipposideros armiger, Hipposideros fulvus, Rhinolophus affinis, Rhinolophus rouxii, Rhinolophus luctus,* and *Myotis siligorensis*. The possible route of invasion of oriental elements is along the Himalaya through northeastern India (Kurup, 1966, 1974) (Fig. 2B). The lone species with Ethiopian affinity, *Rhinopoma hardwickii*, may have entered the region from Pakistan through Punjab and Rajasthan (Chakraborty, 1983) (Fig. 2D). However, it would be erroneous to presume that faunal inflow to the region occurred only through the above routes. There may have been several other ways, albeit smaller, through which some mammalian species entered India (Schaller, 1977). For example, Karanth (2003) pointed out that wet zone species from northeast India could have followed multiple corridors during their dispersal to peninsular India through (1) the Vindhya–Satpura range (Fig. 2C), (2) the Eastern Ghats, (3) the Brij area of northern India, and (4) the Aravali range. Although rich in species diversity, the Himalayan region has relatively few endemic bird species (Martens & Eck, 1995) and the same holds true for mammals. While there is an explanation that species originated in the Himalayas and extended their range post–speciation, the reverse could be true. The Himalayan fauna is predominantly composed of immigrants, from both the Palearctic and Indo–Malayan zoogeographical regions, with very little speciation *in situ* (Martens & Eck, 1995) and hence low endemism. Based on recent evidence, the latter hypothesis seems better–grounded (Johansson *et al*., 2007) and conforms to the faunal dispersal scenario discussed above. With respect to western Himalaya, no endemic species of bats are known.

***Faunal similarity, HP vs. J&K*:** A variety of factors influence faunal resemblance between different regions *e.g.* past faunal interchange, similar climatic conditions, indirect spread from a third region and proximity between the regions (Kurup, 1974). A brief comparison of the bat fauna of HP and J&K is worthwhile, primarily because of the proximity of the two regions, somewhat similar climate and topography, and their shared biogeographic history. At the generic and species level, chiropteran diversity of the two states is fairly comparable, with 18 genera and 32 species in J&K (Bates & Harrison, 1997; Chakraborty, 1983; Saikia *et al.*, 2006) compared with 14 genera and 28 species in HP (Saikia *et al*., 2011). Among these, six genera and 16 species are exclusive to J&K and two genera and 12 species are found only in HP, while 12 genera and 16 species are common to both the regions. Applying Simpson's coefficient, species resemblance translates to 57 percent.

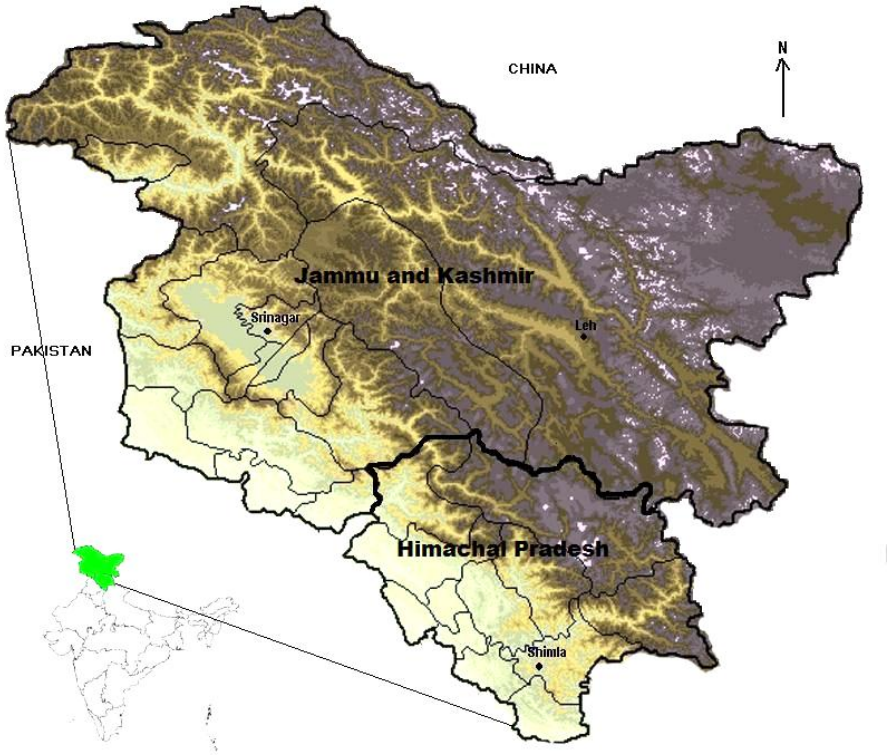

Figure 1: Map of the western Himalaya (Jammu & Kashmir and Himachal Pradesh, India) showing administrative boundaries of Districts.

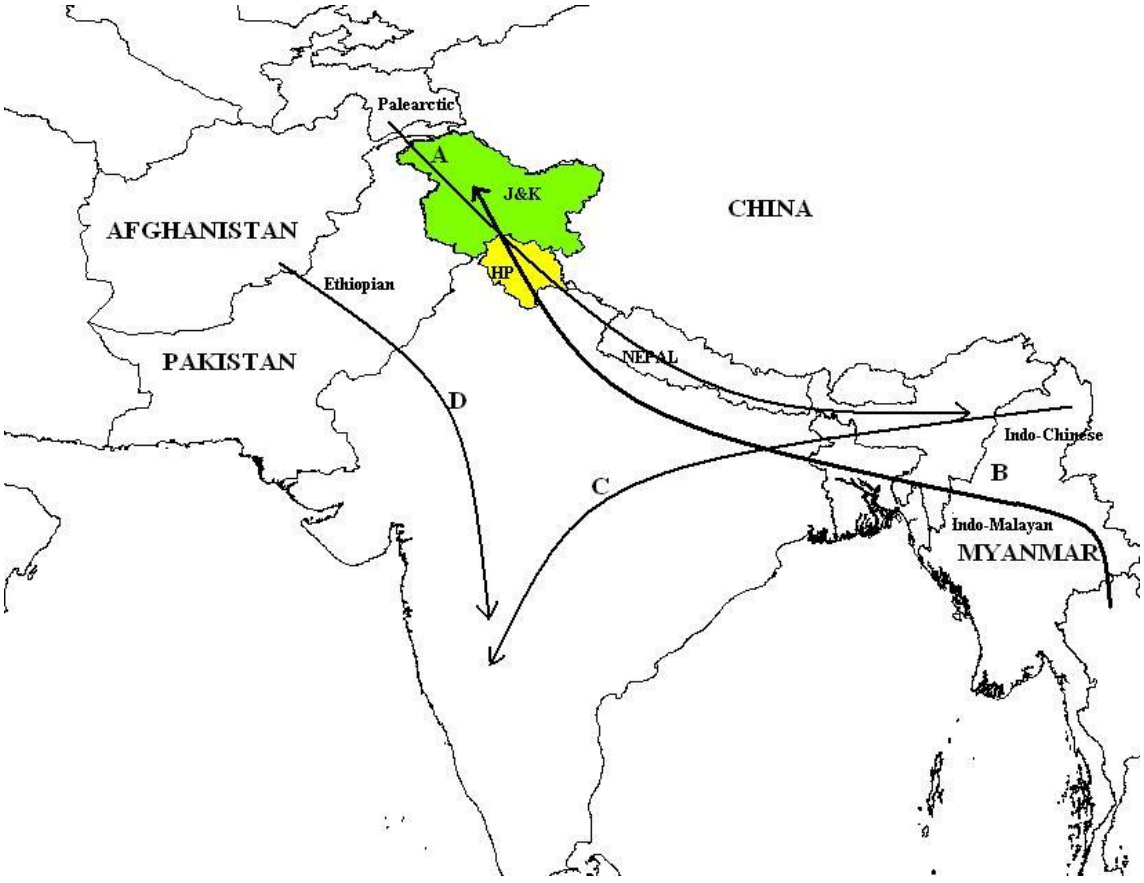

Figure 2: Hypothetical key routes of mammalian invasion to India indicating its possible course over Jammu & Kashmir and Himachal Pradesh. (Modified from Kurup, 1974)

Table 1: Zoogeographic affinity of the Chiropteran species of western Himalaya (P = presence)

Family & Species	Himachal Pradesh	Jammu & Kashmir	Zoogeographic affinity
Pteropodidae			
Cynopterus sphinx Vahl,1797	–	P	Oriental
Pteropus giganteus Brünnich, 1782	P	P	Oriental
Rousettus leschenaulti (Desmarest, 1820)	P	P	Oriental
Megadermatidae			
Megaderma lyra Geoffroy, 1810	P	P	Oriental
Rhinolophidae			
Rhinolophus affinis Horsfield, 1832	P	–	Oriental
Rhinolophus ferrumequinum (Schreber, 1774)	P	P	Palearctic
Rhinolophus hipposideros (Bechstein, 1800)	–	P	Palearctic
Rhinolophus lepidus Blyth, 1844	P	–	Oriental
Rhinolophus luctus Temminck, 1835	P	–	Oriental
Rhinolophus sinicus Anderson, 1905	P	–	Oriental
Hipposideridae			
Hipposideros armiger Hodgson, 1835	P	–	Oriental
Hipposideros fulvus Gray, 1838	–	P	Oriental
Rhinopomatidae			
Rhinopoma hardwickii Gray, 1831	–	P	Ethiopian
Vespertilionidae			
Barbastella leucomelas (Cretzschmar, 1826)	P	P	Palearctic
Eptesicus bottae (Peters, 1869)	–	P	Palearctic
Eptesicus gobiensis Bobrinskii, 1926	–	P	Palearctic
Eptesicus serotinus(Schreber, 1774)	–	P	Palearctic
Hypsugo savii (Bonaparte, 1837)	–	P	Palearctic
Kerivoula hardwickii (Horsfield, 1824)	–	P	Oriental
Miniopterus schreibersii (Kuhl, 1819)	P	–	Indeterminate
Murina tubinaris (Scully, 1881)	P	P	Oriental
Myotis blythii (Tomes, 1857)	P	P	Palearctic
Myotis formosus (Hodgson, 1835)	P	P	Oriental
Myotis longipes (Dobson, 1873)	–	P	Oriental
Myotis muricola (Gray, 1846)	P	P	Oriental
Myotis nipalensis (Dobson,1871)	P	P	Palearctic
Myotis siligorensis (Horsfield, 1855)	P	–	Oriental
Nyctalus leisleri (Kuhl, 1819)	P	P	Palearctic
Nyctalus montanus (Barret–Hamilton, 1906)	P	–	Palearctic
Nyctalus noctula (Schreber, 1774)	P	P	Palearctic
Otonycteris hemprichii Peters, 1859	–	P	Palearctic
Pipistrellus ceylonicus (Kellart, 1852)	P	–	Oriental
Pipistrellus coromandra (Gray, 1838)	P	P	Oriental
Pipistrellus dormeri (Dobson, 1875)	P	P	Oriental
Pipistrellus javanicus (Gray, 1838)	P	–	Oriental
Pipistrellus paterculus Thomas, 1915	–	P	Oriental
Pipistrellus pipistrellus Schreber, 1774	–	P	Palearctic
Pipistrellus tenuis (Temminck, 1840)	P	P	Oriental
Plecotus homochrous Hodgson, 1847	P	P	Palearctic
Plecotus wardi Thomas, 1911	–	P	Palearctic
Scotophilus heathii Horsfield, 1831	–	P	Oriental
Scotophilus kuhlii Leach, 1821	P	–	Oriental
Scotoecus pallidus Dobson, 1876	P	–	Oriental
Vespertilio murinus Linnaeus, 1758	–	P	Palearctic

From a zoogeographic point of view, Oriental species (19) overwhelmingly dominate Palearctic (8) species in HP (affinity of one species being indeterminate), while the number of Palearctic (16) and Oriental (15) elements are almost equal with one Ethiopian counterpart in J&K. Among the 16 species shared by both the regions, nine are oriental and the remaining seven are Palearctic species. The significant presence of Palearctic species in the chiropteran fauna of J&K is primarily a consequence of its geographic location, which lies in the entrance of the key route of faunal inflow of Palearctic elements to India (Kurup, 1974). This incursion

of Palearctic mammals through Northwestern India mostly proceeded towards the east although a feeble influx might have headed towards the south. Cooler and more humid conditions over much of India during some phases of Pleistocene enabled many Palearctic mammals to spread to peninsular India (Schaller, 1977). This is the reason that many of these Palearctic species in this area are also present in the eastern and north–east India while a few like *Pipistrellus pipistrellus* also occur in peninsular India (Korad & Yardi, 2004). In spite of its position in the supposed route of mainstream Palearctic faunal invasion to India, relatively few Palearctic species could colonize HP. However, one should note that compared to the westward Oriental faunal invasion, eastward Palearctic faunal dispersal was smaller in magnitude. Many of these Palearctic bat species are associated with higher elevations and thus could not colonize lower areas. This also explains the absence of these elements in the immediate south of HP *i.e.* the plains of Punjab and Haryana. It may also be noted that the current species range may have little similarity to the past since climatic conditions have changed over time thereby affecting species distribution. The species composition we see today is a product of a long geological history enduring the vagaries of climate and physical events.

The preponderance of Oriental species in HP and also their significant presence in J&K is a testimony of a huge influx of Oriental elements to these regions. During the mid–Miocene period (18–11mya), much of India was probably covered with humid forest which was contiguous with that of Southeast Asia. Even in more recent times (Quaternary period), India probably experienced shrinking and expansion of forest cover due to multiple cycles of dry and wet periods (Karanth, 2003). Although it is difficult to deduce the time of westward Oriental faunal dispersal, expanding forest cover might have served as corridors for dispersal of those elements. However, as observed by Blanford (1901), starting east to Kashmir (*c*.72^0 longitude), the number of typically Oriental species increases whereas these forms gradually disappear west of the Himalaya. Possibly prevailing drier conditions prevented further westward spread of these species. Kurup (1966, 1974) had shown that with respect to mammals, western India (including Jammu and Kashmir and HP) exhibit a good deal of faunal similarity with northeastern India, (Simpson's coefficient of 52). For Chiroptera, if the northwestern states of HP and Jammu and Kashmir are compared together (44 species) with northeastern India (63 species) (Bates & Harrison, 1997; Thabah & Bates, 2002), this similarity (28 species being common) also stands at a significant coefficient of 44. Faunal interchange is known to be one of the most dynamic and potent factors affecting faunal composition of a given region. Such resemblance strongly indicates past faunal interchange between the two regions, although the invasion from the eastern side was predominant as shown by comparatively larger portion of Oriental elements in western Himalaya (approx. 57% of total bat species) compared to the smaller presence of Palearctic fauna in the north–eastern India.

Disjunctive distribution of taxa: The supposed route of influx of Oriental elements to northern India is along Himalaya from north–eastern India. Interestingly, a few Oriental species like *Cynopterus sphinx, Myotis longipes, Scotophilus heathii, Pipistrellus paterculus* and *Kerivoula hardwickii* have reached Jammu and Kashmir (Chakraborty, 1983; Bates & Harrison, 1997) but have not been recorded in HP which comes earlier on this invasion route. Similarly, a few Palearctic species from J&K like *Eptesicus serotinus* and *Pipistrellus pipistrellus* have invaded northeastern India with a major disjunction in between. However, considering the lack of field studies, it is logical to expect at least some of these species to occur in the intervening area despite the disjunctive distribution of certain taxa. A number of earlier undocumented species namely *Rhinolophus affinis, R. luctus, Myotis siligorensis, Hipposideros armiger* and *Miniopterus schreibersii* have recently been recorded from HP (Saikia *et al*., 2004). Species like *Myotis longipes, Kerivoula hardwickii, Pipistrellus paterculus and Pipistrellus pipistrellus* are apparently disjunctively distributed in mainland India. *Myotis longipes* has a highly disjunct distribution in Kashmir and Meghalaya (Molur & Srinivasulu, 2008). Taxonomy of small and big footed *Myotis* is complex and this species is very difficult to identify (Molur *et al*., 2002). Possibly the bat has thus far evaded detection in HP because of its rarity coupled with under–

sampling and complex identification issues, or it may be absent altogether. Similarly, *Kerivoula hardwickii* is another uncommon bat in India and is known from a few localities in Assam, Mizoram, Meghalaya, Nagaland, West Bengal, J&K and Karnataka (Rosell–Ambal *et al*., 2008; Pearch & Writer, 2009). The apparent rarity of this species in India may reflect its secretive nature (Molur *et al*., 2002) and may be the reason for its supposed absence in HP. *Eptesicus serotinus* has been reported from Mussoorie in neighbouring Uttarakhand and it is very likely to be present in HP. *Pipistrellus paterculus* is known from J&K, Bihar, Assam, Manipur and Nagaland (Bates & Harrison, 1997). Likewise, *Pipistrellus pipistrellus* is known from a few localities in J&K, Maharashtra and north–east India. If the observed disjunctive distribution of the above species is true, two alternative scenarios can be imagined. Firstly, some of these species could have dispersed to India through various smaller corridors other than the supposed major pathways of mammalian invasion. Alternatively, a few of them could also represent relict populations of earlier widespread species which became obliterated with changed climatic conditions, as suggested by Mani (1974b). Nonetheless, the presence of some of these Palearctic and Oriental elements in north–eastern India and also in northern India is again a testimony of past faunal exchange as discussed above.

Barring one species *Nyctalus montanus*, all other Palearctic species in HP are also present in J&K. However, it is considered likely that this species does occur in the state (unconfirmed report, Molur *et al*., 2002) due to the geographically forward position of J&K when considering a Palearctic invasion to India, and due to the comparable physio–climatic conditions of J&K and HP. Unfortunately, despite the impressive diversity and interesting zoogeographic milieu, the western Himalaya remains underexplored as far as species of Chiroptera are concerned. Our current understanding of the geographical and ecological distribution of bat species in this region is limited. Furthermore, in view of the recent advances in bat systematics, especially the discovery of cryptic diversity amongst some of the currently recognized forms, the existing inventories of bat fauna of the region probably substantially underestimate the species diversity. Thus, any zoogeographic inferences discussed above are necessarily crude. It is expected that intensive systematic studies will significantly add to the species inventory and will also shed new light on the zoogeography of the bat fauna of this region.

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